Quantitative Evaluation of the Carbon Isotopic Labelled Urea Breath Test for the Presence of *Helicobacter pylori*

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Abstract

The ^{14}C and ^{13}C labelled urea breath tests (UBT) for detecting *Helicobacter pylori* infection are well established but scope for improvement exists in both to reduce some of their shortcomings.

For this study, the ^{14}C UBT investigation focussed on reducing the quantity of radioactive tracer that is administered to the subject undergoing this test, with the aim of lowering the radiation dose to the patient, reducing the impact to the environment and exempting the test from radioactive materials licensing. Wider acceptance, availability, affordability to lower socio-economic groups and third party medical treatment payers and using readily available equipment were factors considered when developing the method.

The principle of the method developed is to collect larger volume breath sample, quantitatively absorbing a defined volume of extracted breath CO_2 in an efficient CO_2 trapping agent using a specifically designed apparatus and measuring the activity with a low background β-spectrometer.

A reduction in the quantity of ^{14}C labelled urea administered to the patient was achieved. The method also reduced the counting error margin at a lower detection limit, improving discrimination between *H. pylori* positive and negative patients.

The ^{13}C UBT is a non-radioactive test however, it is substantially more expensive. The ^{13}C UBT investigation aimed to determine whether commercially available un-enriched urea could be used thus reducing the cost of the ^{13}C UBT.

A simple protocol with Isotope Ratio Mass Spectrometry (IRMS) for the measurement was used as opposed to the well-established ^{13}C UBT protocol. The principle of the ^{13}C UBT investigation was to detect the change of the breath $\delta^{13}C$ ($^{13}C/^{12}C$) ratio after the administration of un-enriched urea with a $\delta^{13}C$ different to the exhaled breath. Theoretical calculations showed that an administered dose of 500mg un-enriched urea with at least a 10‰ $\delta^{13}C$ difference may be detectable using IRMS.

In vitro investigations confirmed that levels of 0.01 to 0.001‰ $\delta^{13}C$ were detectable by IRMS. A change in the $\delta^{13}C$ of a standard breath CO_2 was confirmed for a range between 0.14 to 50% $^{v}/_{v}$ mixed CO_2 samples, i.e. the projected range for *in-vivo* investigation. Results from the *in-vivo* investigation however were not able to distinguish positive from negative *H. pylori* patients. The use of the 1000mg dose of urea appears to have caused

saturation of the enzyme. It was concluded that some enrichment of the ^{13}C is necessary or less urea be used.